BETA STRAND

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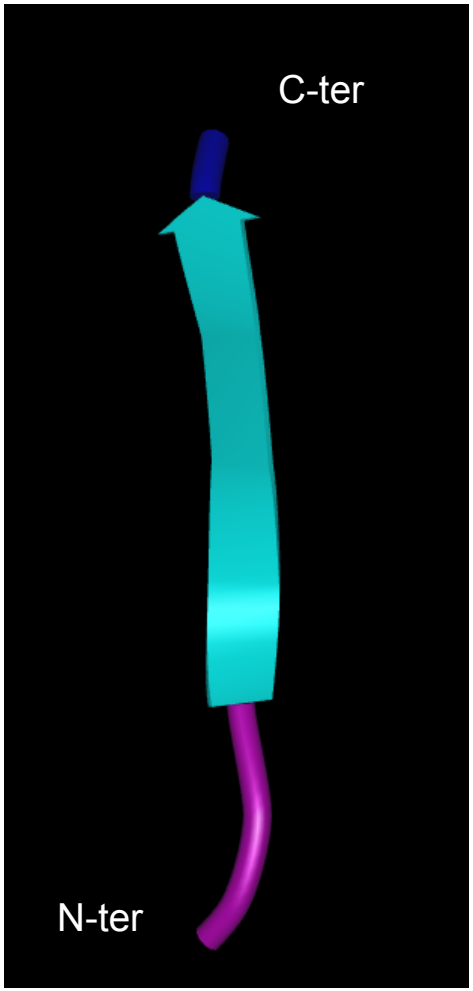

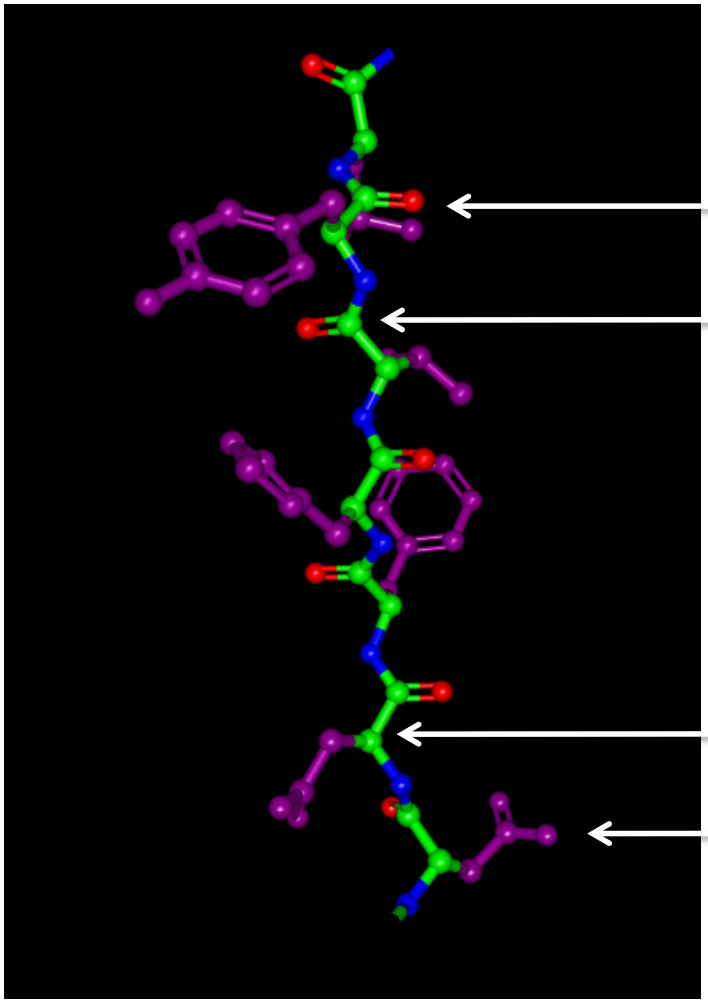

NH and CO groups:
right, left, right…
(plane of the slide)

R groups:
Front, back, front...
(plane of the slide)

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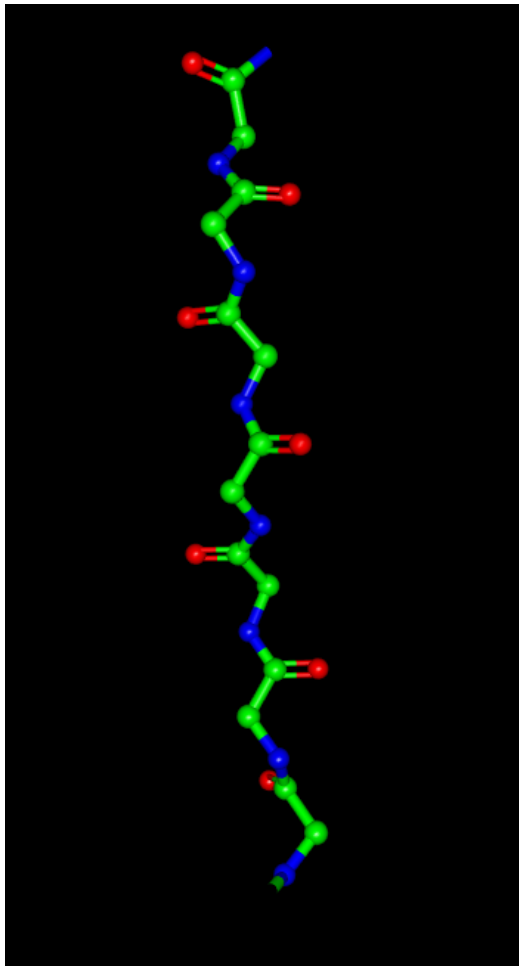
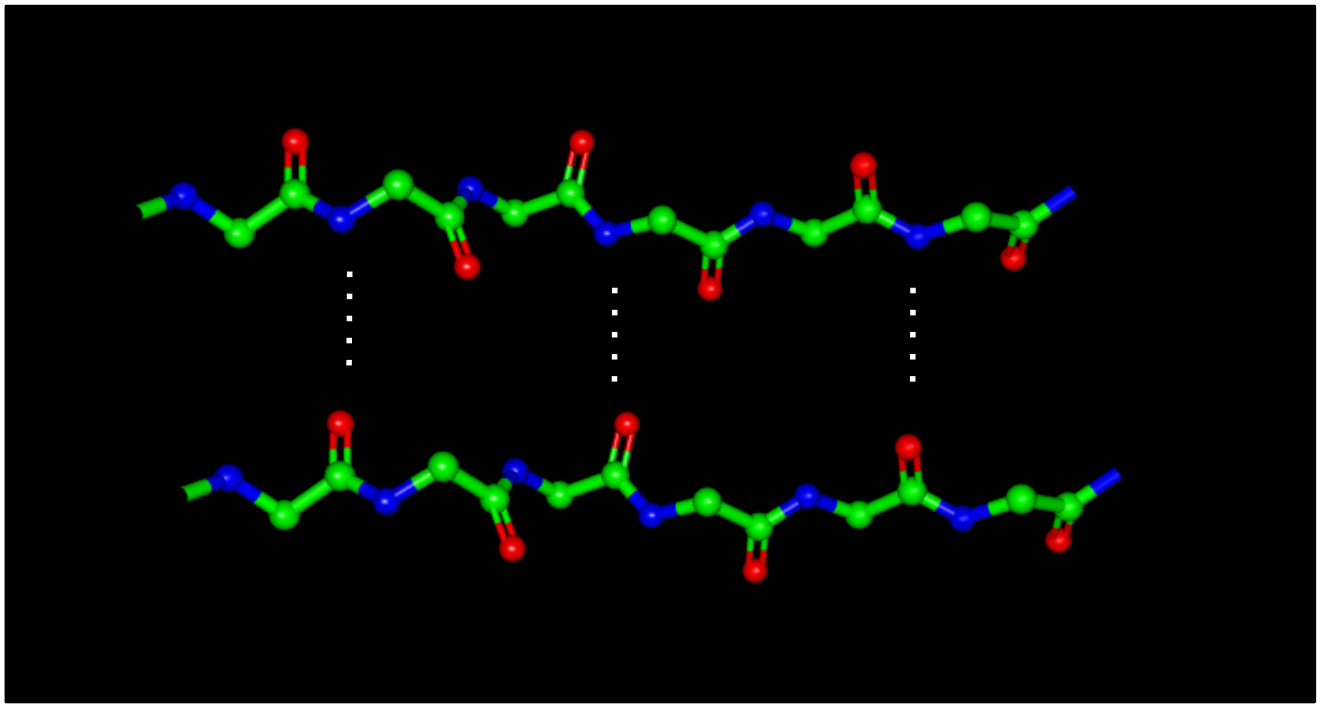


Intra-strand hydrogen bonds are hampered by the extended conformation of beta strands.



Inter-strand hydrogen bonds are favoured.

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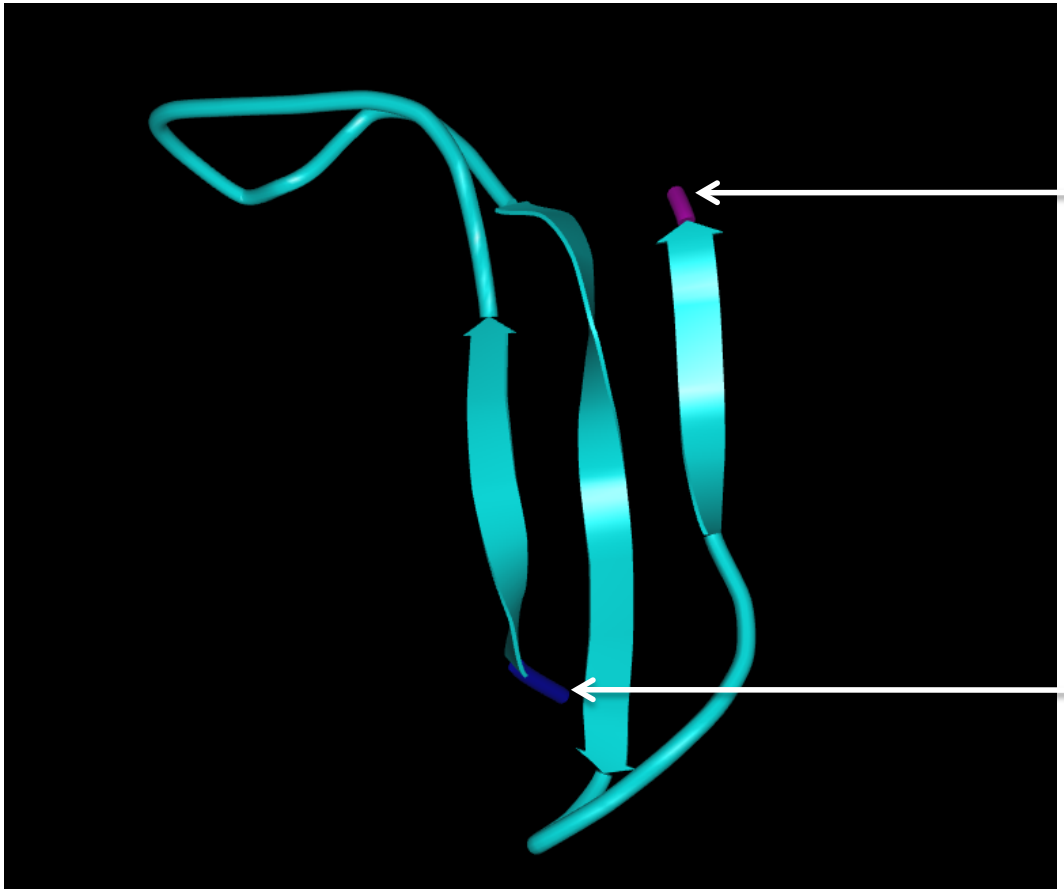

C-terminus

By convention, the N-ter side of a beta strand is represented as the base of an arrow. The C-ter side is depicted as the head of an arrow.

N-terminus

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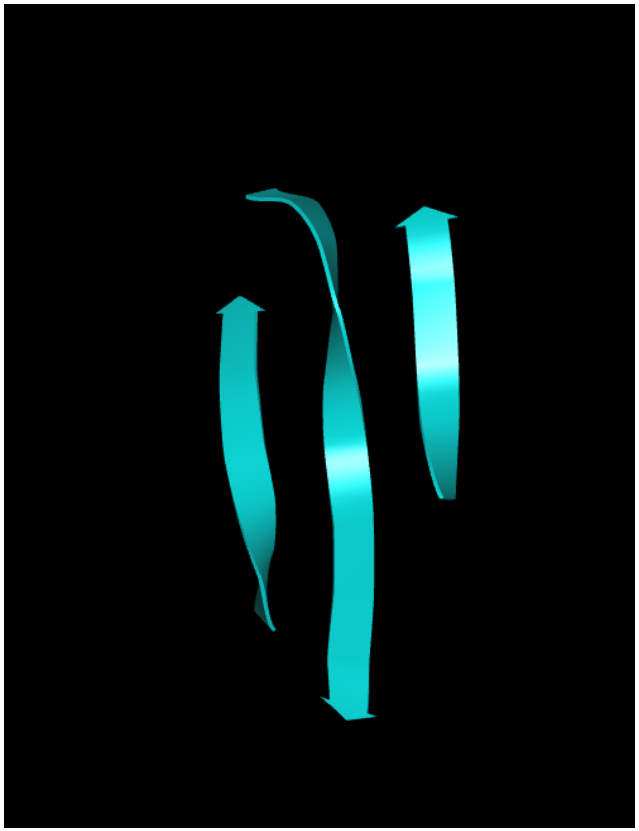
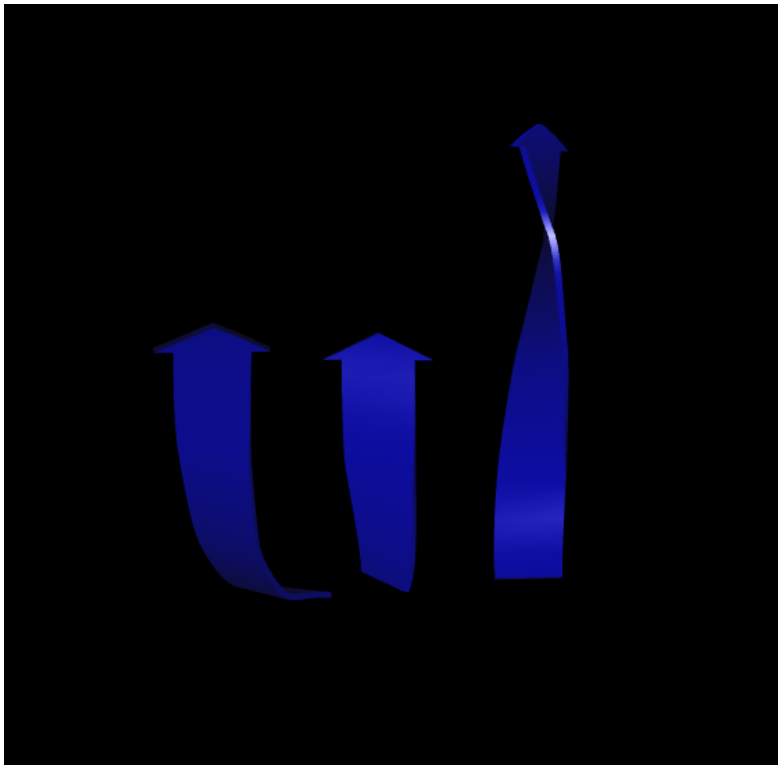


Beta strands can mutually interact, forming a beta sheet. The orientation of strands can be parallel or anti-parallel.



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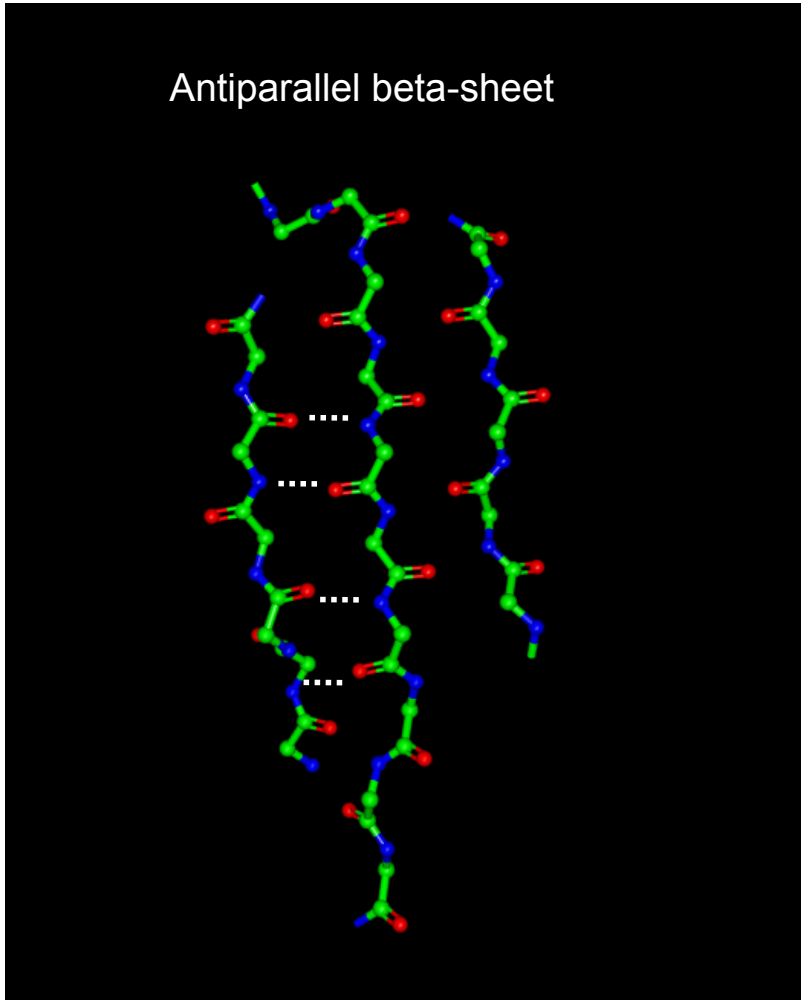
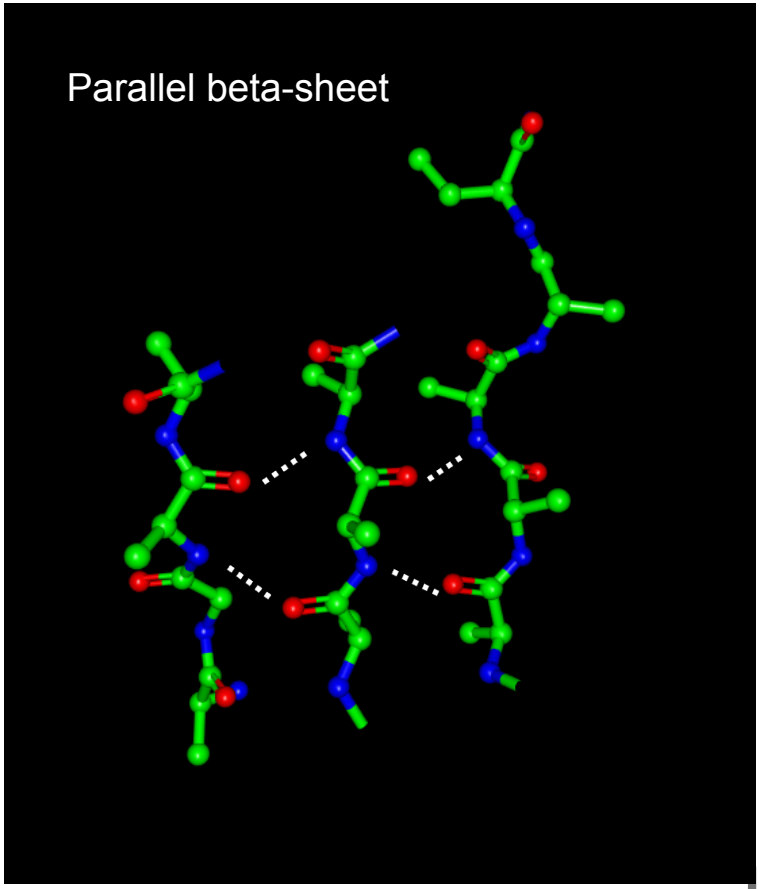


Hydrogen bonds in beta-sheets



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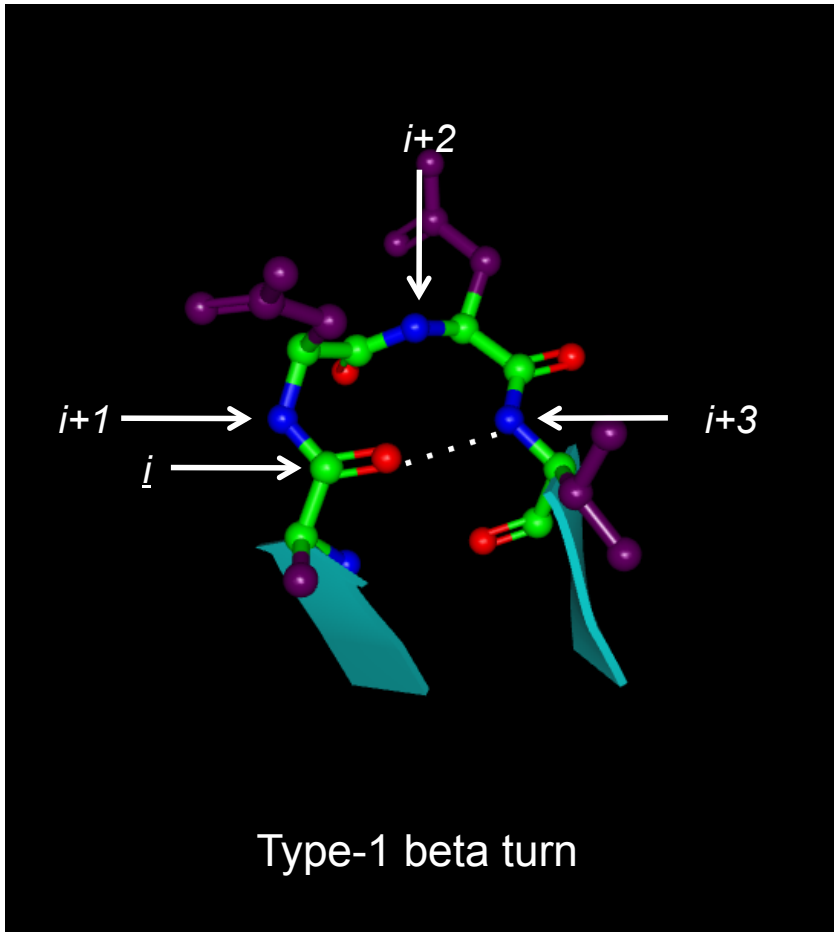

Type-1 beta turn

Two beta strands can be connected via a type-one turn.

Hydrogen bond between *i* and *i+3* residues.

Any of the 20 amino acids can reside at *i* and *i+2* sites.

Carbon C' of *i+1* residues and R-group of *i+2* amino acid are directed toward opposite directions (C' of *i+1* down, and R of *i+2* up, respectively).
Clash between *i+1* carbonyl and *i+2* R is avoided.

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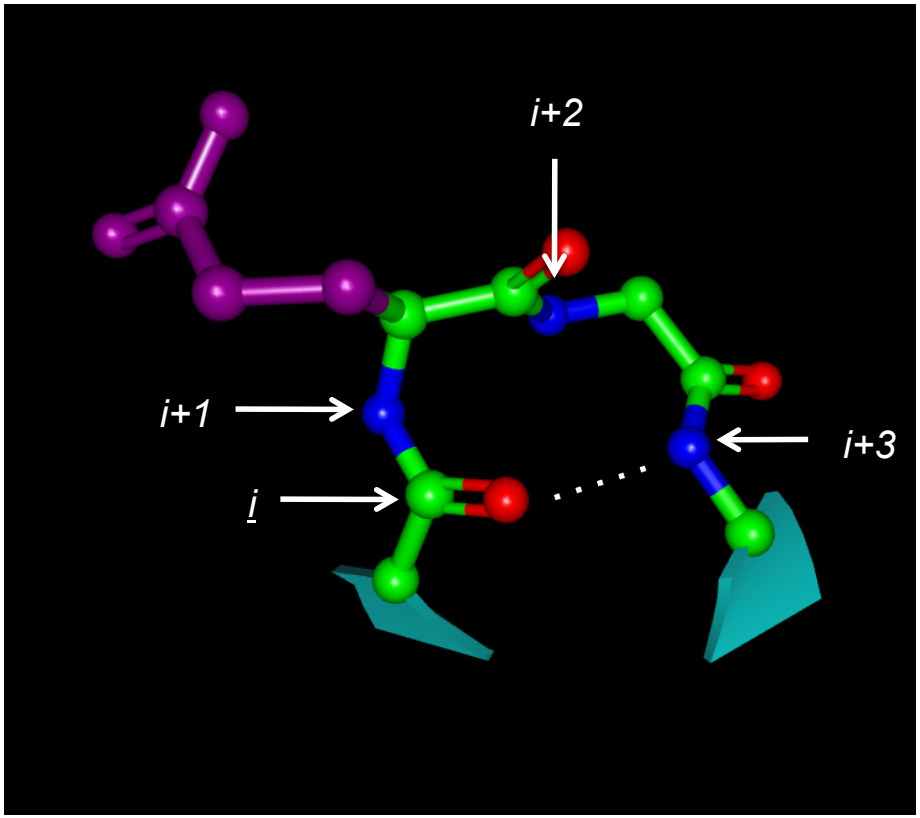
Type-2 beta turn



Two beta strands can be connected via a type-two turn.

Hydrogen bond between *i* and *i+3* residues.

Glycine must reside at *i+2* site.

Carbon C' of *i+1* residue and R-group of *i+2* amino acid are directed toward the same direction.
Clash between *i+1* carbonyl and *i+2* R is avoided by the presence of glycine.

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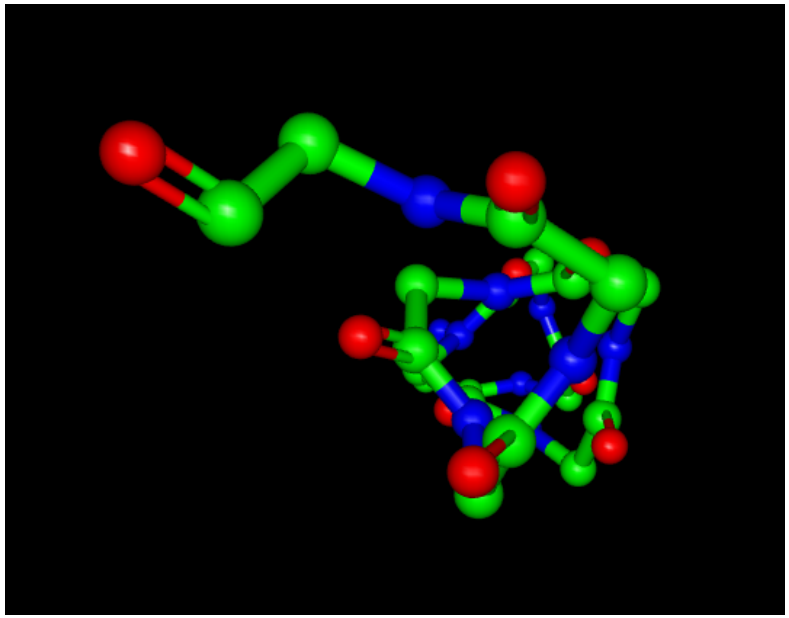
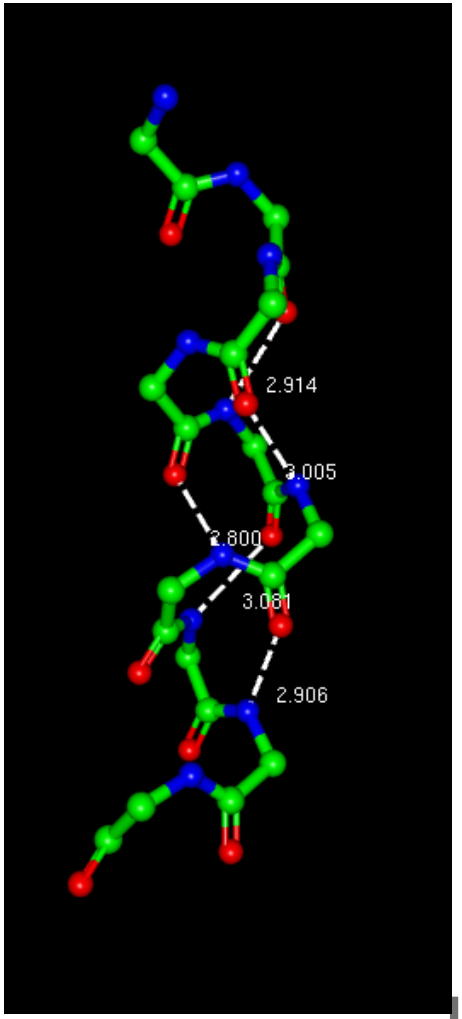
Helix 3.0_{10}
Periodicity: 3 residues/turn
The groove contains 10 atoms
Narrower than alpha helix





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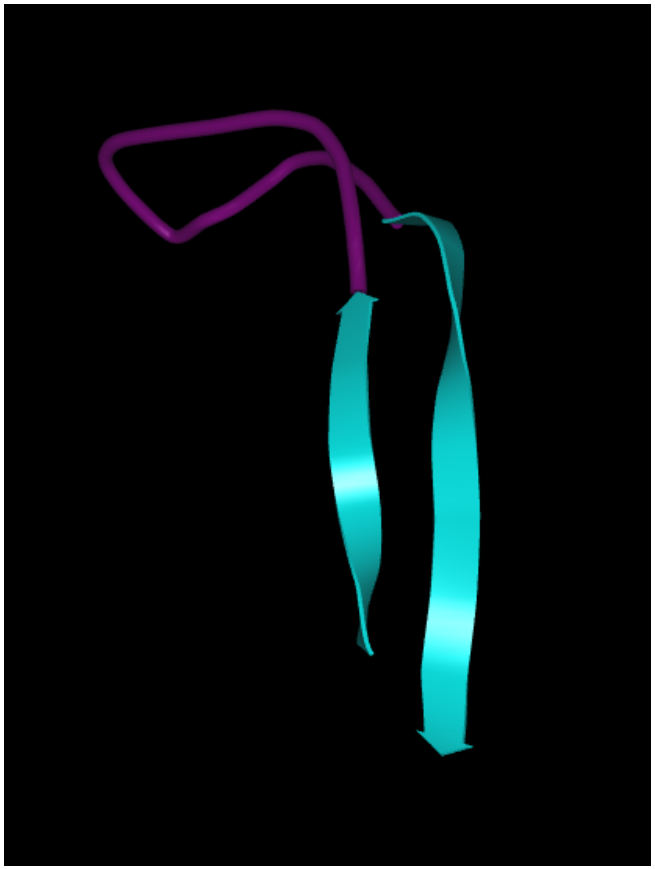
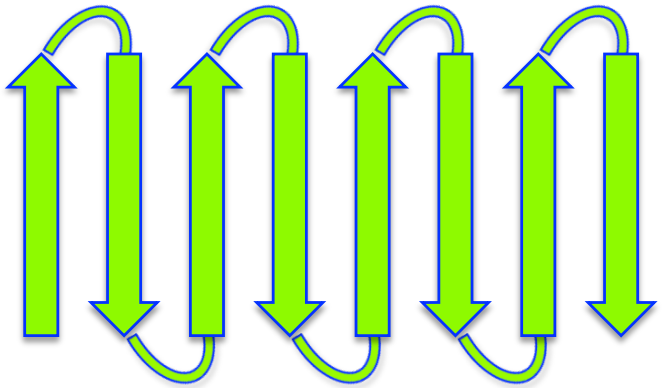
Beta turn



Structural motif

- two contiguous antiparallel beta strands
- connection by a loop
- present in proteins also containing alpha helices (isolated beta turn)
- repetition of the beta turn yields a sheet



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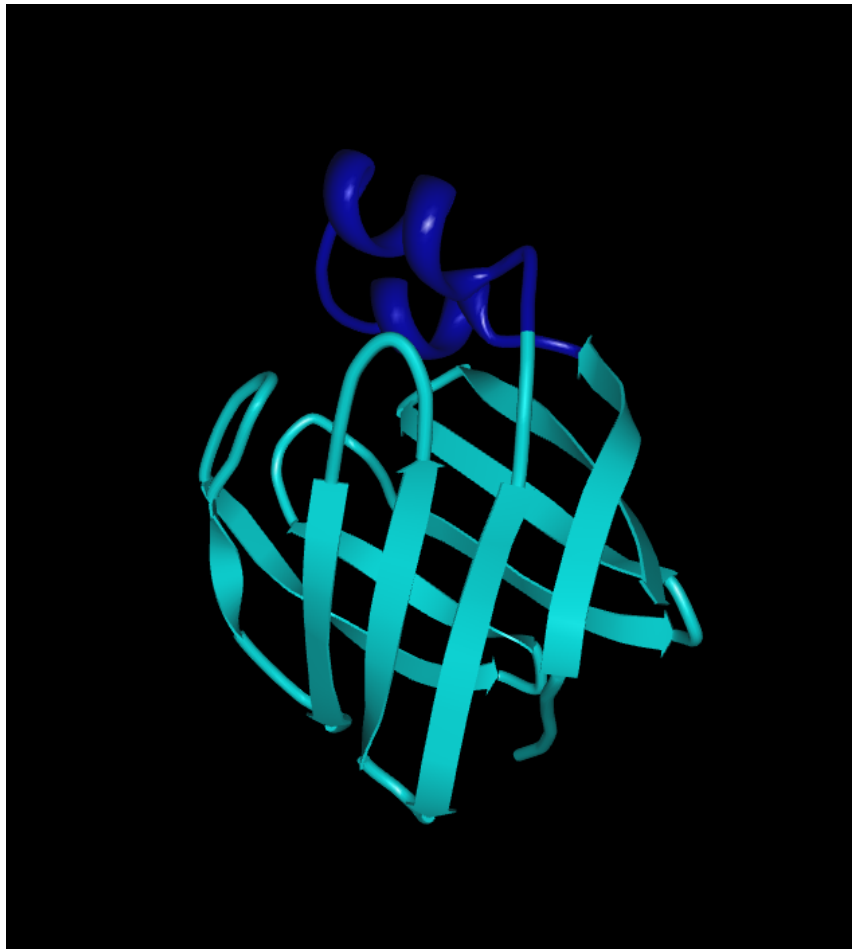

Retinol-binding protein
Binding and transport of vitamin A

Antiparallel strands forming two sheets.
n strand connected to *n+1*, *n+1* to *n+2*…
The two sheets form a barrel.
The barrel cavity binds retinol.
The beta strands are connected by:
- two small alpha helices
- turns

Turns can be of two types:
- type-1 beta-turns
- type-2 beta turns (contain glycine)

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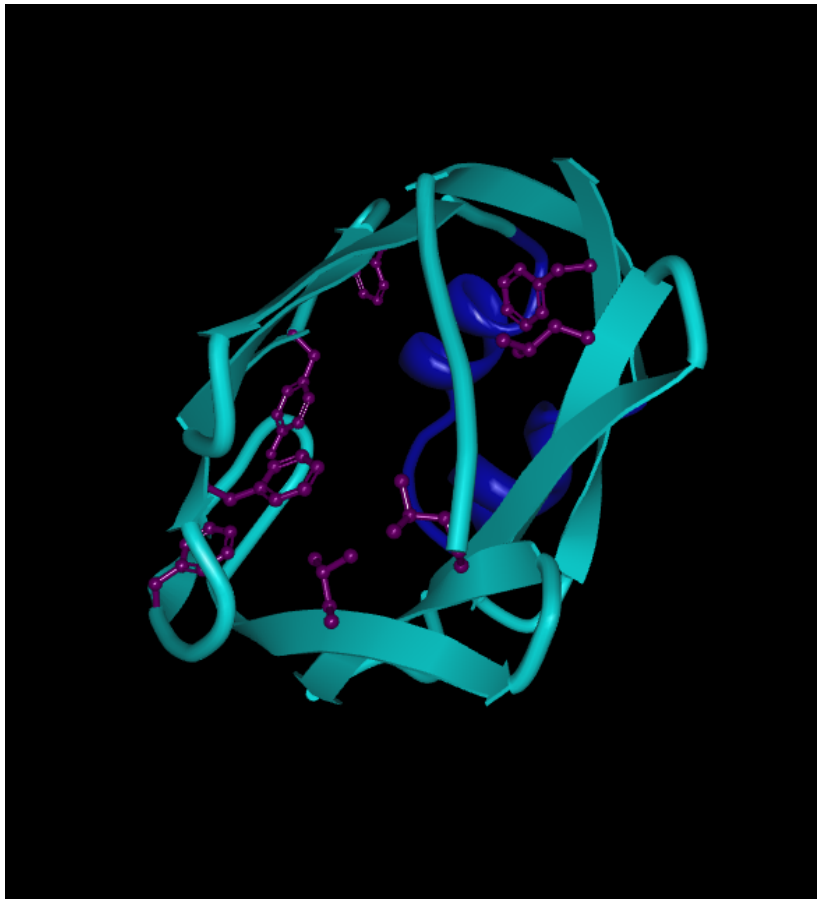
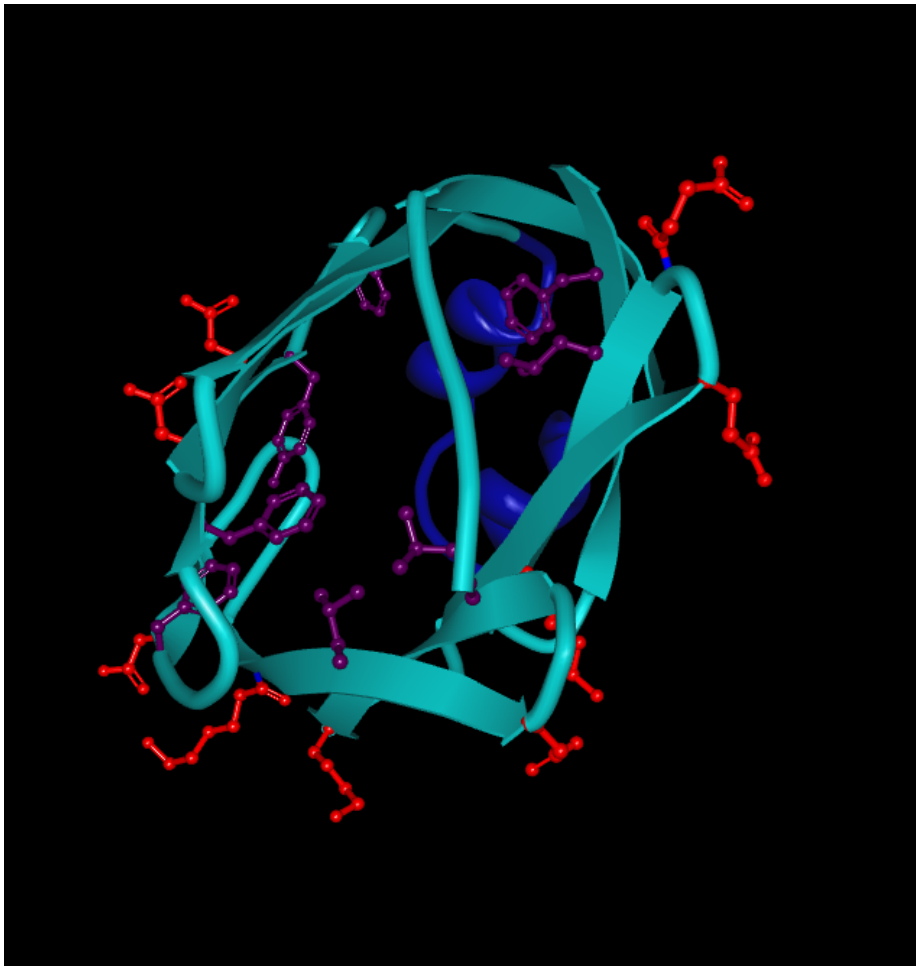
Hydrophobic residues fill the cavity





Charged residues on the surface

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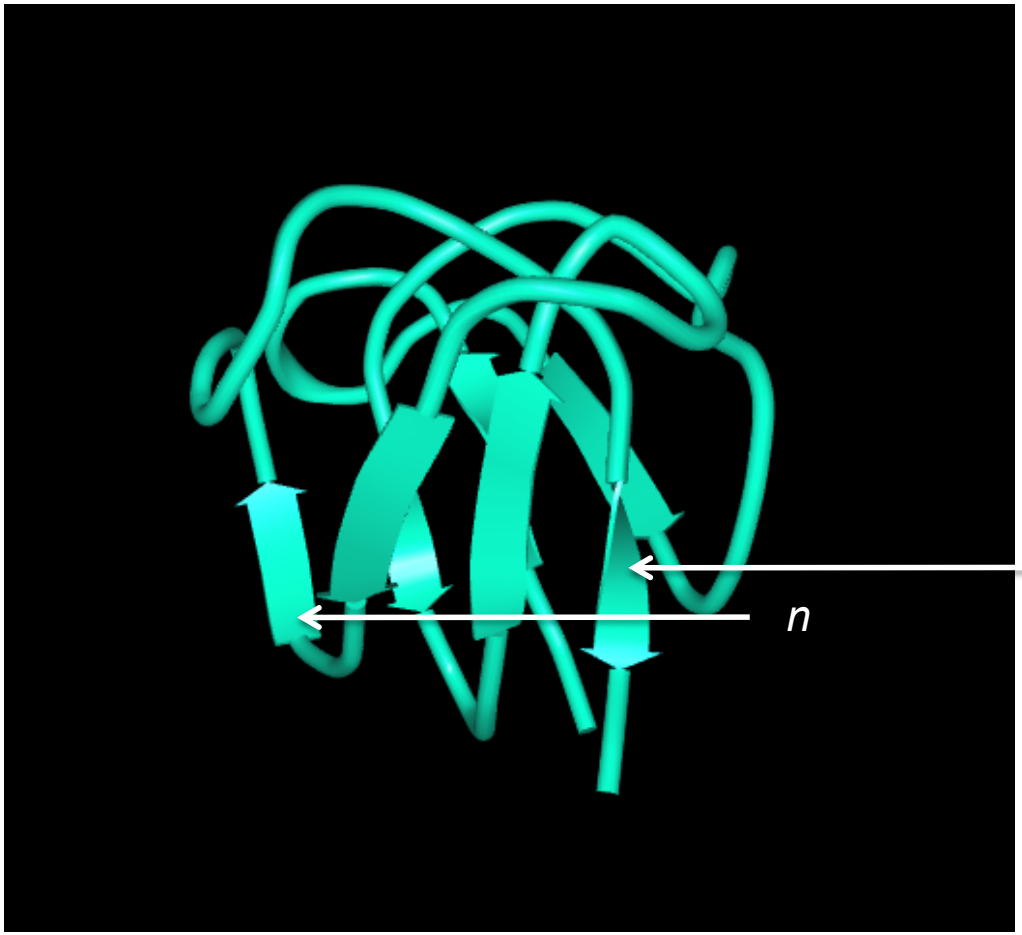

Bovine gamma-crystallin

Antiparallel strands forming two sheets.
n strand connected to *n+3*
The barrel is crossed by the connection between stands.

This structural motif is denoted as “greek key”.

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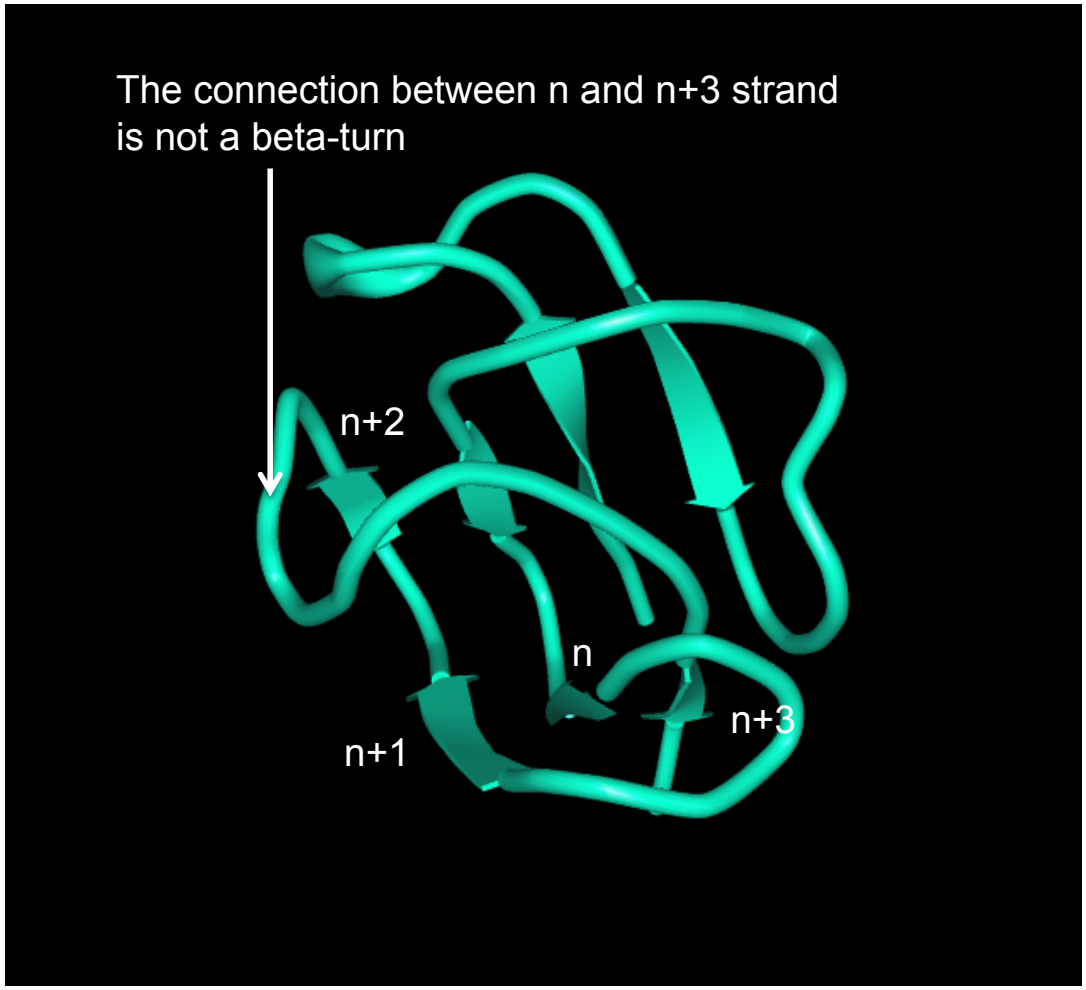

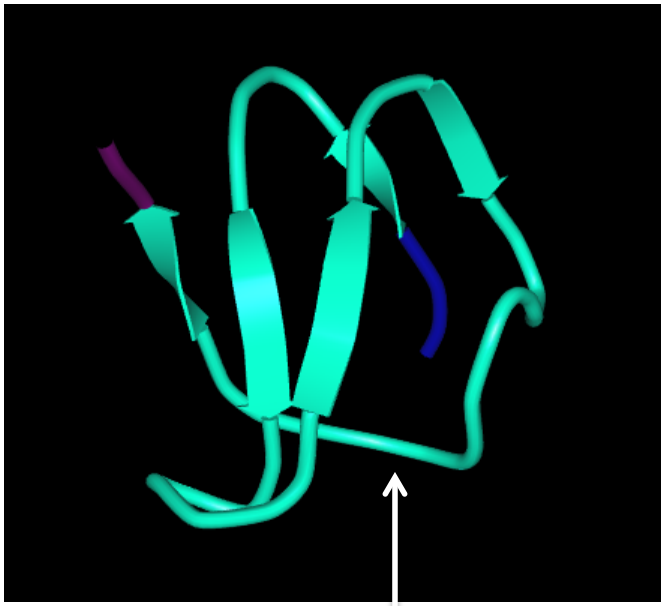

The cavity of the barrel is crossed by the connection between strands *n* and *n+3*

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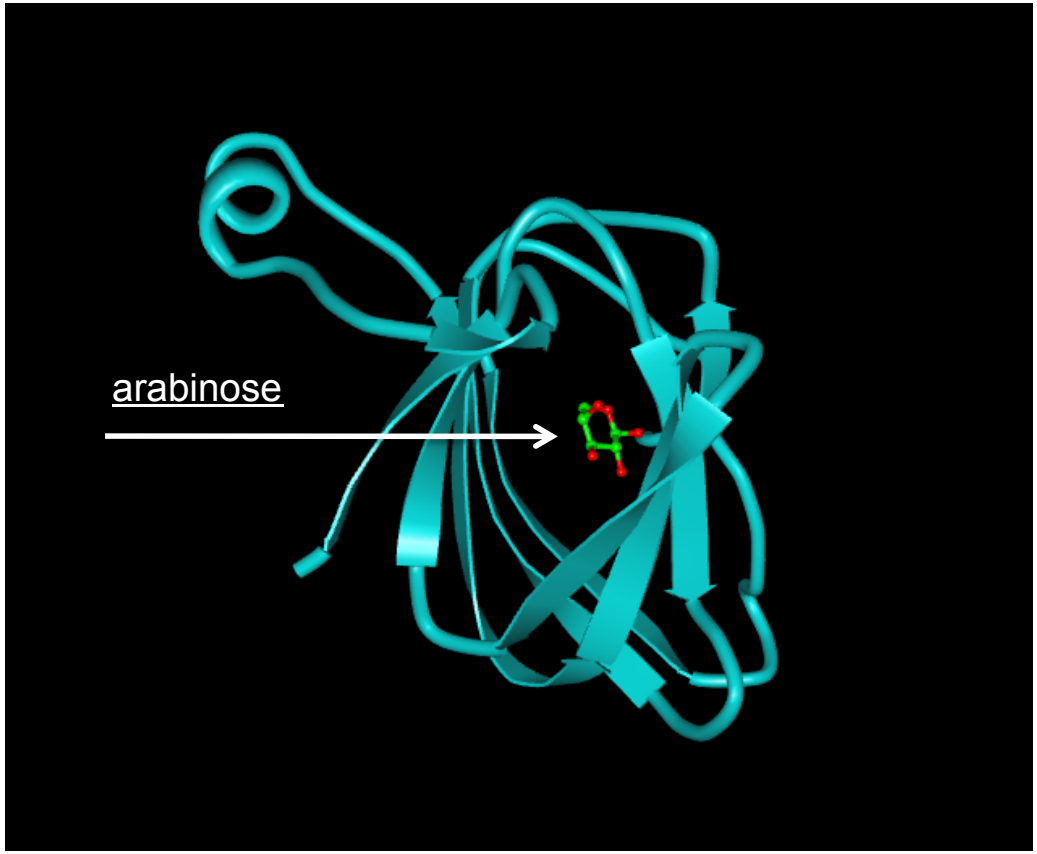
AraC protein of *Escherichia coli*



Barrel formed by antiparallel beta-sheets.

Transcriptional regulator

The N-terminal domain binds arabinose. The C-ter domain binds DNA. AraC is a dimer. Free AraC represses genes of *araBAD* operon. When AraC is bound to arabinose, *araBAD* genes are transcribed.

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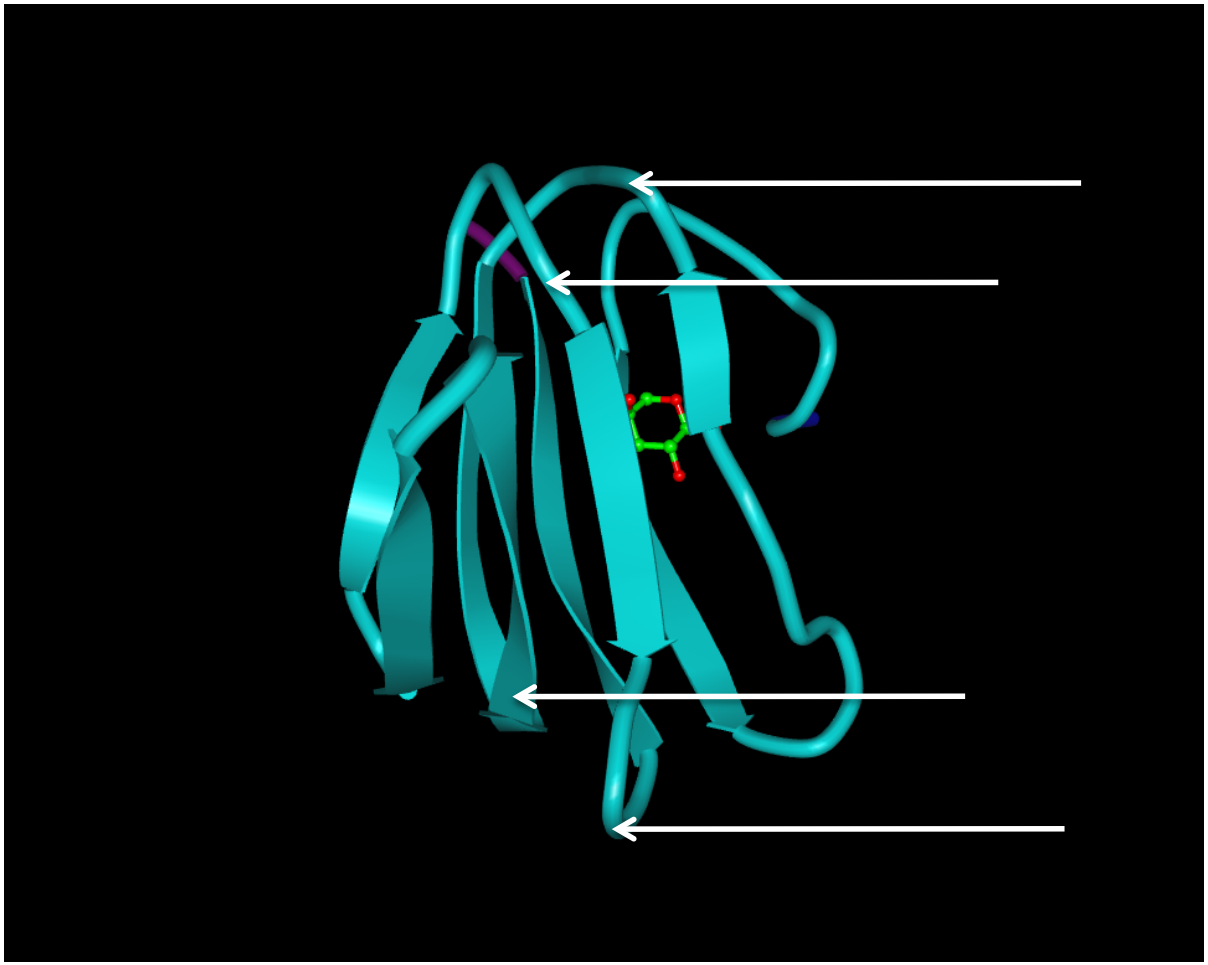

Jelly Roll motif:

the barrel is crossed 4 times by connections between strands.
The motif resembles a “jelly roll”, an english candy decorated in a typical way.

Greek key motif:

the barrel is crossed 1 time by connections between strands.

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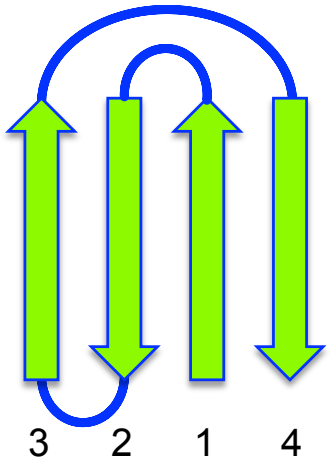
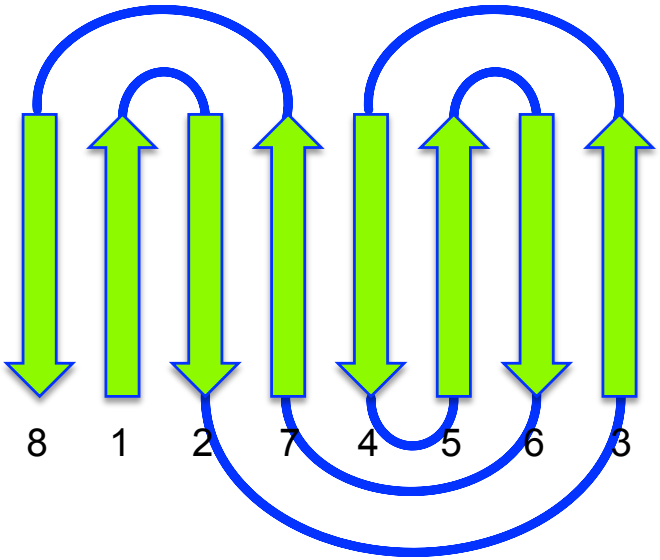
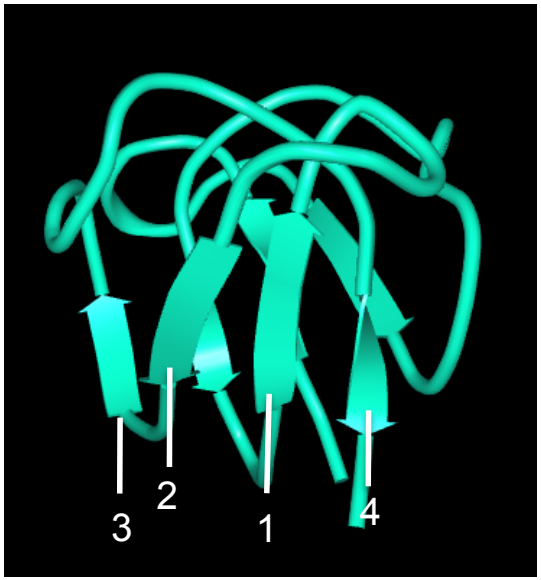




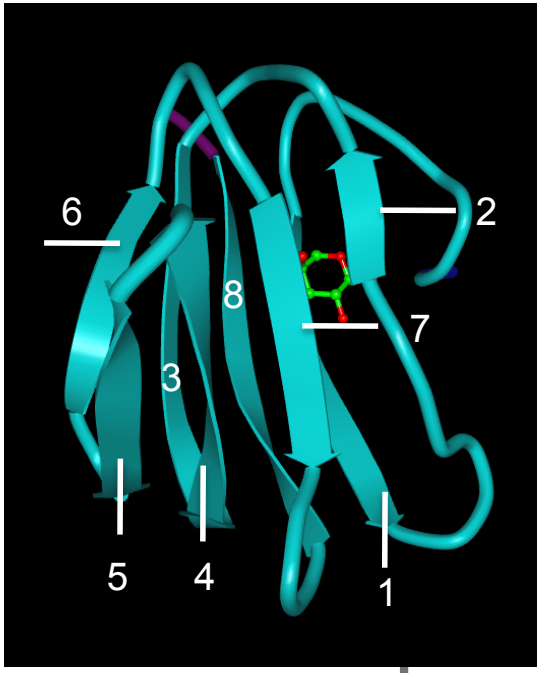
Jelly Roll:

- 8 beta strands
- 2 antiparallel sheets
- the barrel is crossed by 2-3, 3-4, 6-7, and 7-8 loops



Greek key:

- 4 beta strands
- 1 antiparallel sheet
- the barrel is crossed by 3-4 loop
- two greek keys can form a barrel



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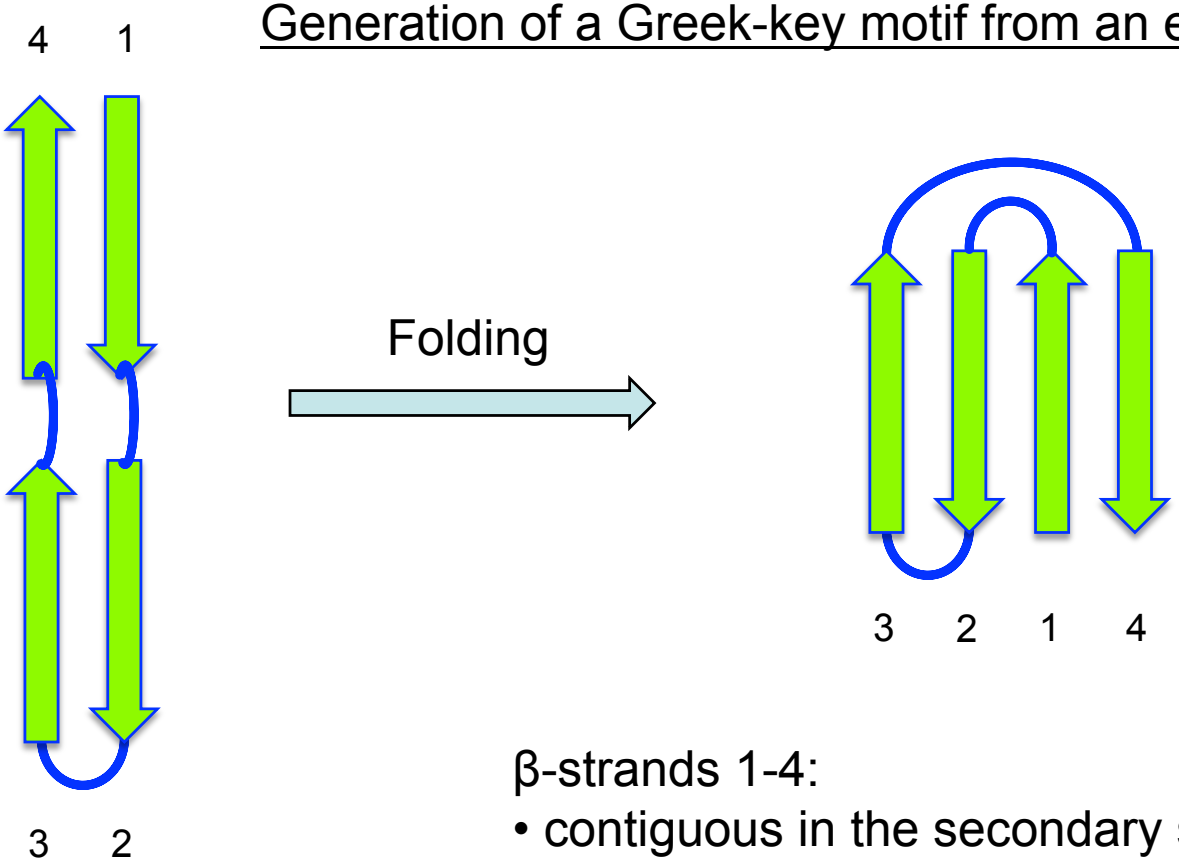
Generation of a Greek-key motif from an extended conformation



β-strands 1-4:

- contiguous in the secondary structure
- non-contiguous in the tertiary structure

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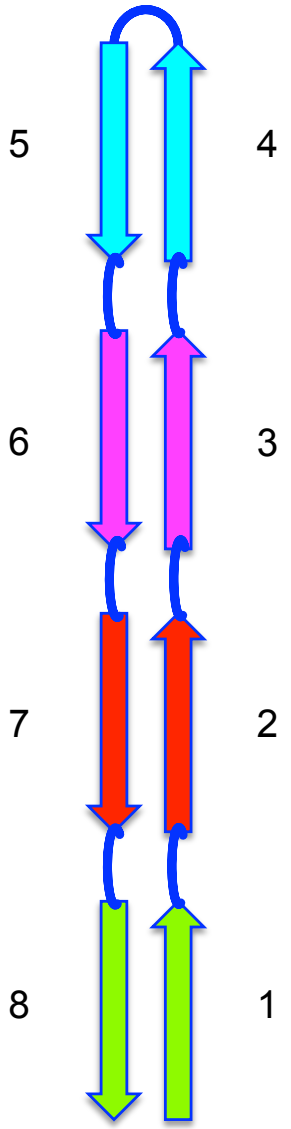
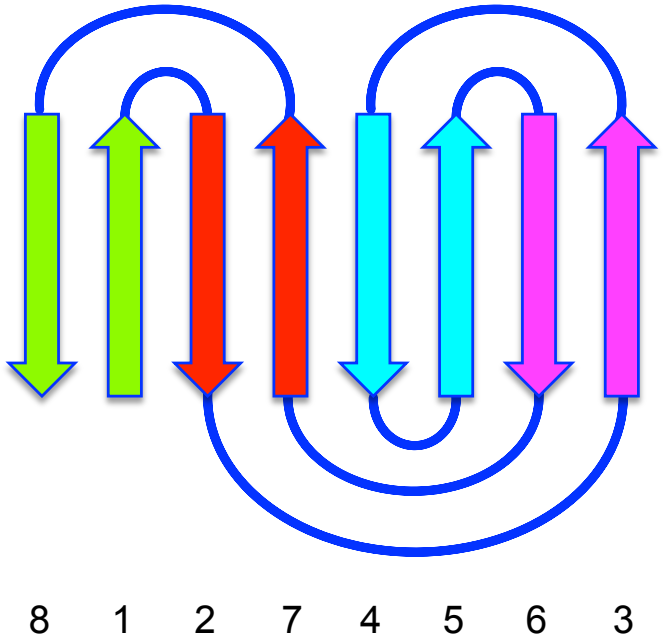


Generation of a Jelly-Roll motif from an extended conformation

Folding



Connections 2-3 and 6-7: cross the bottom of the barrel
Connections 3-4 and 7-8: cross the top of the barrel

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